Remarks/Arguments

Applicants respectfully request reconsideration of this application in view of the following remarks. Claims 1, 3-9, 11, 12, 14-24, 26-31, 33-37, 39 and 40 are amended, claims 10, 13 and 25 are canceled, and claims 41-43 are added. As a result, upon entry of the amendment claims 1-9, 11, 12, 14-24 and 26-43 are pending, with claims 1, 16 and 31 being independent claims. Because three claims are added and three claims are canceled for a net addition of zero claims, it is believed that no additional fees are due for the consideration of this paper. However, if fees are due, the Commissioner is authorized to charge such fees to deposit account number 13-2855.

Claim Amendments

It is respectfully submitted that the claims as amended above are supported by the application as originally filed in the Patent Office on September 30, 2003, that the amended claims satisfy the written description requirement and the other requirements of 35 U.S.C. § 112, and that no new matter is being added. Claim 1 is amended in the preamble to more clearly recite that the communication bus interrupts the transmission of electrical signals in response to the detection of a fault condition in the bus, and in the body of the claim to more clearly recite that the transmission paths extend between the first and second ends of the communication bus to which the process devices are connected. Additionally, "first" is added in reference to the control unit and the switch unit in claim 1 and where appropriate in the subsequent dependent claims for the sake of clarity where the second control and switch units are introduced in new dependent claim 41. Claim 3 is amended to remove the fourth transmission path and to more clearly recite that the first control unit detects the fault condition on the third communication path and to cause the first switch unit to move to the open position to interrupt the flow of electrical signals along the first and second transmission paths. Claims 10 and 13 are canceled, and claims 4-9, 11, 12, 14, 15, 39 and 40 are amended for consistency with the amendments to claims 1 and 3. The amendments to the claims are supported by the application as originally filed at least at Fig. 4 and the accompanying text at page 11, paragraph [0035] through page 19, paragraph [0059] that illustrate and discuss the safety device 40 of the communication bus that includes first communication path 25 and second communication path 27 between the first and second ends of the bus that are connected to the control room 30 and device(s) 32, respectively. The safety device 40 includes a first control unit 80 and a first switch unit 50, 52, with the first control unit 80 detecting a fault condition in the communication bus and causing the first switch unit 50, 52

to interrupt the flow of electrical signals along the transmission paths 25, 27 by opening the contacts 70a, b, 72a, b. The first control unit 80 may be connected to a third transmission path 29 of the communication bus and may cause the first switch unit 50, 52 to interrupt the flow of electrical signals along the transmission paths 25, 27 in response to detecting the fault condition on the third transmission path 29.

Claim 16 is amended to more clearly recite that the communication bus includes first, second and third transmission paths, that the fault condition is detected on the third transmission path, and that the first switch unit is opened to interrupt the flow of electrical signals along the first and second transmission paths in response to detecting the fault condition on the third transmission path. In a similar manner as claim 1, "first" is added in reference to the control unit and the switch unit and where appropriate in the subsequent dependent claims for the sake of clarity where the second control and switch units are introduced in new dependent claim 43. Claim 25 is canceled and claims 17, 19-24 and 26-30 are amended for consistency with the amendments to claim 16. Claim 18 is amended to properly recite the Markush group of current, voltage and resistance. These amendments are supported by the application as originally filed in a similar manner as described above at least at Fig. 4 and the accompanying text at page 11, paragraph [0035] through page 19, paragraph [0059] wherein the first and second transmission lines may be the first pair of wires 25 and second pair of wires 27, respectively, the third transmission path may be the third pair of wires 29 and/or fourth pair of wires 37, and the first control unit 80 may detect the fault condition on the third transmission path and cause the interruption of the flow of electrical signals along the first and second transmission paths in response.

Claim 31 is amended to more clearly recite that electrical signals are communicated between the first and second process devices along first and second transmission paths of the communication bus, that electrical signals are also communicated along a third transmission path of the communication bus, and that the flow of electrical signals along the first and second transmission paths are interrupted in response to detecting a fault condition on the third transmission path. Dependent claims 33-37 are amended for consistency with the amendments to claim 31. These amendments are supported by the application as originally filed in a similar manner as described above at least at Fig. 4 and the accompanying text at page 11, paragraph [0035] through page 19, paragraph [0059].

New claim 41 depends from claim 3 and recites a fourth transmission path between the first and second ends of the communication bus, a first switch assembly proximate the first end of the communication bus and a second switch assembly proximate the second end

of the communication bus. The first switch assembly includes the first control unit and first switch unit, the second switch assembly includes a second control unit and second switch unit, and both switch assemblies are coupled to each of the first, second, third and fourth transmission paths. The second control unit is configured to detect a fault condition on the fourth transmission path, and to cause the second switch unit to interrupt the flow of electrical signals along the first and second transmission paths in response to detecting the fault condition on the fourth transmission path. New claim 42 depends from claim 41 and recites that at least one of the switch assemblies is housed in a protective enclosure. New claim 43 depends from claim 21 and recites similar limitations as claim 41 of a fourth transmission path, and a second control unit and a second switch unit of the safety device. The new claims are supported by the application as originally filed at least at Fig. 4 and the accompanying text at page 11, paragraph [0035] through page 19, paragraph [0059] wherein the safety device 40 includes a second switch assembly 44 with a second control unit 82 connected to a fourth transmission path and a second switch unit 54, 56 connected to the first and second transmission paths 25, 27. The second control unit 82 detects a fault condition in the communication bus on the fourth transmission path and causes the second switch unit 54, 56 to interrupt the flow of electrical signals along the transmission paths 25, 27 by opening the contacts 74a, b, 76a, b. The first and second switch assemblies 42, 44 may be housed within one or more protective enclosures, such as explosion-proof enclosures or purge enclosures.

Applicants respectfully submit that the amendments to claims 1, 3-9, 11, 12, 14-24, 26-31, 33-37, 39 and 40, and the addition of new claims 41-43, do not present new matter and do not raise new issues, and respectfully request entry of the present amendments and consideration of the claims as amended.

Claim Rejections under 35 U.S.C. § 103(a)

Applicants respectfully traverse the rejections of each of claims 1-40 as obvious over U.S. Pat. No. 6,594,603 ("Eryurek et al.") in view of U.S. Pat. Nos. 6,912,671 ("Christensen et al.") and 6,385,166 (Takagi et al.). Reconsideration and withdrawal of the rejections is respectfully requested.

The present invention is directed to a communication bus for use in a hazardous area that is capable of detecting a fault condition **on the bus** and respond by interrupting the flow of electrical signals along the transmission paths of the bus. In doing so, the communication bus reduces or prevents the occurrence of sparks or arcing when a fault condition exists that may cause an explosion in the hazardous area. One embodiment of the communication bus is

illustrated in Fig. 4 (shown below) and discussed at paragraphs [0035]-[0059] of the application as originally filed.

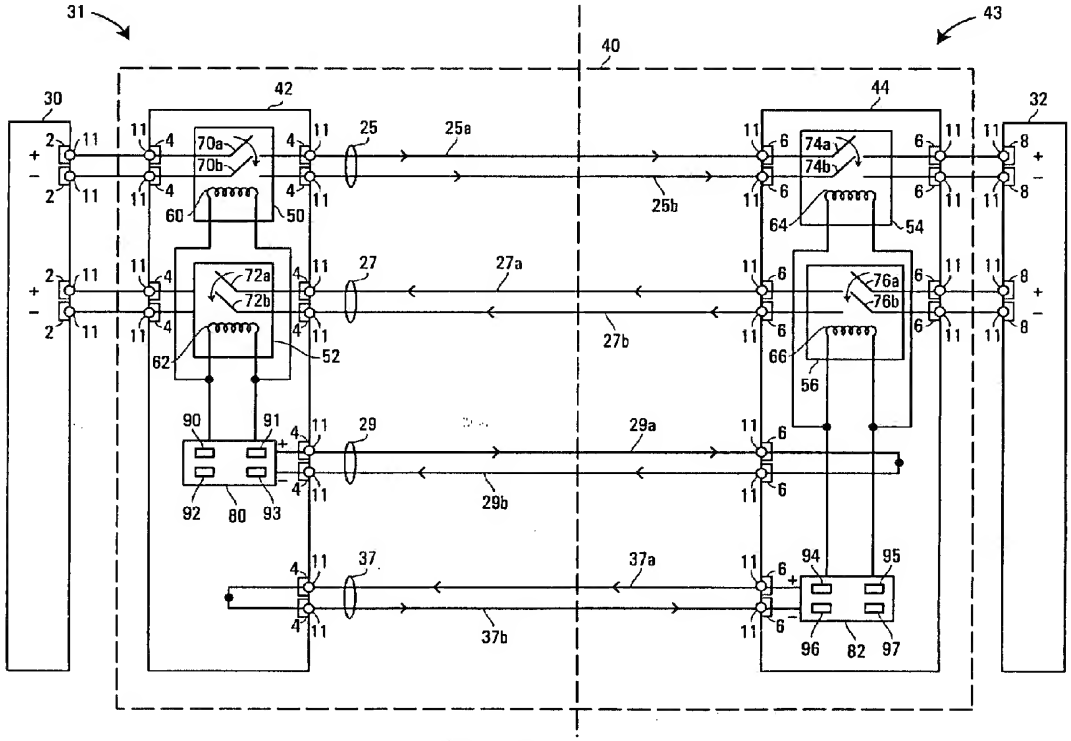

FIG. 4

The communication bus has a first end connected to a first device, a control room 30, and a second end connected to a second device(s) 32. First and second transmission paths are formed by wire pairs 25 and 27, respectively, extend between the ends of the communication bus so that electrical signals may flow between the devices 30, 32. Third and fourth transmission paths are formed by wire pairs 29 and 37, respectively, but do not connect the devices 30, 32, and instead extend between first and second switch assemblies 42, 44 of the communication bus. The safety device 40 of the communication bus includes a first control unit 80 connected to the third transmission path at the first switch assembly 42 and a second control unit 82 connected to the fourth transmission path at the second switch assembly 44, thereby forming two loops between the switch assemblies 42, 44 that are not also connected to the devices 30, 32 for the flow of electrical signals between the devices 30, 32. The first control unit 80 is connected first and second relays 50, 52 of the first switch assembly 42 that are connected to wire pairs 25, 27, respectively, and the second control unit 82 is connected to third and fourth relays 54, 56 of the second switch assembly 44 that are connected to wire pairs 25, 27, respectively.

The control units 80, 82 control the corresponding relays 50-56 to open and close contacts of the relays 50-56 to alternately prevent and allow the flow of electrical signals between the devices 30, 32. The control unit 80 forms a loop with the wires 29a, 29b of the third transmission path, and is configured to generate a signal on the loop and to detect a fault condition in the loop and, consequently in the communication bus, based on the value of an electrical characteristic associated with the third wire pair 29 such as current flow, voltage or resistance. In the illustrated embodiment, the control unit 80 may include a signal source 91, sensor 93 and a comparator that operate to determine whether the measured characteristic has a normal operational value indicative of a normal operating condition of the communication bus, or a value indicative of a fault condition such as a current drop to zero when one of the wires 29a, 29b is severed and creates an open circuit condition. Under normal operating conditions, the control unit 80 cause the relays 50, 52 to be closed to allow the flow of electrical signals on the first and second transmission paths, but upon the detection of a fault condition on the third transmission path, the control unit 80 may open the relays 50, 52 at the first end of the communication bus to stop the flow of electrical signals along the first and second transmission paths and potentially prevent a dangerous condition in the hazardous area. Similarly, the control unit 82 forms a loop with the wires 37a, 37b of the fourth transmission path, and opens the relays 54, 56 at the second end of the communication bus to stop the flow of electrical signals along the first and second transmission paths upon the detection of a fault condition on the fourth transmission path.

With this understanding of the claimed invention, it will be apparent that the claims as amended are not rendered obvious by the references applied in the Office action because none of the references, either alone or in combination, disclose a communication bus suitable for use in a hazardous area that would interrupt the transmission of electrical signals in response to detection of a fault condition in a manner to automatically reduce or prevent the conditions rendering the fault condition hazardous, such as sparking or arcing.

The Eryurek et al. patent resistive element diagnostics for a process device 4, but does not disclose or suggest interrupting transmissions on a communication bus 8 in response to detecting default conditions on the bus 8. The reference teaches diagnostics testing circuitry 16 within the process device 4 for detecting degradation of a resistive element 12 of the device while the device 4 remains online. (*See, e.g.,* Eryurek et al. patent, Abstract). The bus 8 includes two wires connecting the device 4 to a control room 6 and forming a control loop, but the patent provides no teaching of either detecting a fault condition on the bus 8 or interrupting the flow of electrical signals on the bus 8 in response to detecting a fault

condition on the bus 8. The passage at column 6, lines 13-16 of the Eryurek et al. patent referenced by the Office action as allegedly indicating that the communication bus is suitable for use in a hazardous area in fact pertains only to the process device circuitry 28 within the device 4. The bus 8 is merely disclosed as being a pair of wires connecting the device 4 to the control room 6, and no additional configuration of the bus 8 for use in hazardous environments is disclosed. Consequently, the sole teaching of the Eryurek et al. patent relevant to the claims of the present application is the use of two wires to connect a pair of device with signals flowing in one direction on one wire and in the opposite direction on the other wire.

The Christensen et al. patent teaches a method for detecting, diagnosing and reporting wiring faults in a process control system, but does not teach the interruption of the flow of electrical signals **in response to detecting** a fault condition. The references teaches many different diagnostics tests that may be performed at a linking device 28 of a process control system 10 to detect wiring faults on a bus 30, but provides no suggestion of interrupting the flow of electrical signals on the bus 30 upon detection of a wiring fault. The diagnostic tests include measuring resistance on the bus 30 (block 158), measuring voltage on the bus 30 (block 160), measuring noise levels on the bus 30 (block 164), determining whether a ground signal line of the bus 30 is improperly connected (block 166) and measuring the capacitance between a pair of bus lines (block 168). Per the specification, the diagnostics tests are initiated during commissioning of the system 10, periodically during the operation of the system 10 and/or in response to a request by a system operator (Christensen et al., col. 14, lines 41-56), but not in response to the occurrence detection of a fault condition. In short, the tests are performed preventatively and not responsively. Moreover, when the diagnostic tests detect a wiring fault on the bus 30, the fault is reported to the system operator (*see* Christensen et al., Figs. 4A, 4B and 5, blocks 204, 208, 212, 216, 224, 228, 302, 308 and 312; col. 4, lines 4-16, col. 7, lines 44-48, col. 8, line 59 through col. 9, line 3, col. 12, lines 49-57, col. 12, line 66 through col. 13, line 5, col. 13, lines 13-20, 26-31, 47-50 and 55-67, col. 14, lines 14-22, 26-31 and 35-40), but the Christensen et al. patent does not interrupt the flow of electrical signals on the bus 30 in response to detecting the wiring fault as recited in the claims of the present application.

The final reference, the Takagi et al. patent, does not disclose interrupting the electrical signals on a bus in a manner that is suitable for use in a hazardous area. Consequently, the reference would not be combined with the Eryurek et al. and Christensen et al. patents to yield the invention recited in the claims of the present application. The

Takagi et al. patent discloses a communication apparatus 21 for an automobile having a communication bus 22 with a first communication bus group 23 for the instruments 25-27 of the instrument panel and a second communication bus group 24 for the electrical components of the car doors 29-32. The communication apparatus 21 further includes an electronic control unit 28 having a control circuit 34 connected to the communication bus groups 23, 24 by monitoring circuits 44, 45 and disconnect circuits 38, 39, respectively. The control circuit 34 monitors data transmitted on the communication bus groups 23, 24 via communication lines 35, 40, 41, and detects trouble on the communication bus 22 when pulse signals cannot be transmitted or received via any of the communication lines 35, 40, 41.

Upon detection of a problem, the control circuit 34 performs an operation for identifying the troubled portion of the bus 22 while the flow of electrical signals is maintained on at least a portion of the bus 22. Initially, the control circuit 34 stops communications on the door communication bus group 24 by activating the second bus disconnect circuit 39. At this time, communications on the instrument panel communication bus group 23 can continue. If communications on the bus 22 are feasible when communications are interrupted on the door communication bus group 24, the control circuit 34 determines that the door communication bus group 24 is troubled, and communications on the instrument panel communication bus group 23 are allowed to continue. If communications on the bus 22 are not feasible with the door communication bus group 24 disconnected, the control circuit 34 determines that the instrument panel communication bus group 23 is troubled, deactivates the second bus disconnecting circuit 39 to allow communications on the door communications bus group 24, and activates the first bus disconnecting circuit 38 to stop communications on the instrument panel communication bus group 23. Consequently, at all times a level of communications and flow of electrical signals is maintained on at least a portion of the communication bus 22 of the Takagi et al. patent.

Each of the claims recite limitations that are not taught by these references either individually or in combination. Independent claims 1, 16 and 31 each recite that the flow of electrical signals between first and second transmission paths of a communication bus is interrupted in response to detecting a fault condition in the communication bus. The Eryurek et al. patent simply does not teach interrupting signals on the bus 8 as discussed above. The Christensen et al. patent appears to interrupt signals when the linking device 28 performs diagnostics in order to detect wiring faults on the bus 30, but signals are not interrupted in response to the linking device 28 detecting a wiring fault. Instead, the wiring faults are reported to a system operator. Finally, in the Takagi et al. reference, electrical signals

continue to flow on the communication bus 22 on the one of the communication bus groups 23, 24 that is not currently being evaluated by the control circuit 34. Diagnosis and isolation of the problem with the communication bus 22 is performed while maintaining communications on a portion of the bus 22. It would not be obvious to a person skilled in the art to implement the diagnosis of the Takagi et al. patent in a hazardous area with the transmission of electrical signals continuing after an issue is detected. If the fault condition occurs on the second portion of the bus to be tested, sparking or arcing may still occur on the operative portion, thereby maintaining the hazardous condition and the risk of explosion. Because none of the references teach the interruption of electrical signals during a fault condition as recited in claims 1, 16 and 31, it follows that pending claims are not rendered obvious by the proposed combination of references.

Claims 3, 16 and 31 further recite the communication bus including a third transmission path on which the fault condition may be detected, with the flow of electrical signals on the first and second paths being interrupted upon detection of the fault condition. None of the references appear to teach a communication bus with three transmission paths, let alone interrupting the flow of electrical signals on first and second transmission paths in response to detecting a fault condition on the third transmission path. Consequently, the references fail to render the claims obvious for this additional reason.

Regarding claims 41 and 43, a fourth transmission path is recited, and a fault condition may be detected either proximate a first end of the communication bus on the third transmission path or proximate a second end of the communication bus on the fourth transmission path. The flow of electrical signals on the first and second transmission paths is interrupted in response to detecting the fault condition on either the third or fourth transmission path. The Eryurek et al. system does not detect faults on the bus 8 or interrupt signals. The Christensen et al. and Takagi et al. patents teach the detection of wiring faults or other issues at only a single location along their busses: the linking device 28 and the control circuit 34, respectively. Consequently, the applied references teach fault detection at most at one location along a communication bus, and not at two as recited in new claims 41 and 43, and these claims are not rendered obvious by the references for this still further reason. Many of the remaining claims recite limitations that are also not found in the applied references, but further discussion is not believed to be necessary in view of the distinctions over the references already discussed herein.

CONCLUSION

For at least the foregoing reasons and those presented in applicants' previous response, reconsideration and withdrawal of the rejection of the claims and allowance of the currently pending claims are respectfully requested. Should the Examiner wish to discuss the foregoing or any matter of form in an effort to advance this application towards allowance, Examiner Hoang is urged to telephone the undersigned at the indicated number.

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Respectfully submitted,

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